ART. XVI. A NEW CYLINDRODONT RODENT FROM THE OLIGOCENE OF MONTANA

By J. J. Burke

(Plates XXVI-XXVII)

In the course of study of the Oligocene Tertiary collections made by the late Earl Douglass for the Carnegie Museum, I have had at hand for some time material representing an undescribed species of cylindrodont rodent which Douglass discovered in the McCarty's Mountain Oligocene of Madison County, Montana, in 1903. Until the present, I have refrained from publishing a description of the Douglass specimens, mainly because of their fragmentary nature. However, in the summer of 1937, a Carnegie Museum field party re-investigated the original Douglass locality, and discovered some excellently preserved specimens, which, together with the Douglass material, form the basis of the present description.

As in previous studies, I have been generously aided in this work through the loan of comparative material by the American Museum of Natural History at New York, the U. S. National Museum at Washington, and the Field Museum of Natural History at Chicago. Mr. Sydney Prentice of the Carnegie Museum made the drawings for the illustrations in this paper.

Order SIMPLICIDENTATA Lilljeborg

Family CYLINDRODONTIDÆ* Miller and Gidley

Genus Pseudocylindrodon Burke

Pseudocylindrodon medius sp. nov.

Holotype: Right ramus of mandible with broken incisor, P_4 and M_{1-3}, Carnegie Museum No. 9999.

*I feel that the rodent genera *Mysops* (as delimited by Wilson), *Pareumys*, *Pseudocylindrodon*, *Cylindrodon* and *Ardynomys* constitute a valid family assemblage. Tentatively, pending further study I am also including *Tsaganomys* and *Cyclomylus* in the family. Since communicating with R. W. Wilson and studying new fossil specimens now at hand, I hesitate to place *Sespemys* in this group; in any case I prefer not to pass upon the affinities of the latter genus until I can see the types of *Sespemys thurstoni* Wilson.

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Referred specimens: Skull, well-preserved, but brain case somewhat shattered in parietal region, left malar missing, specimen distorted by crushing on right side of occiput and in right pterygoid region, and RP^3 lost, C. M. No. 10001.

Skull, anterior portion, zygomatic arches and nasals lost, RI and LP^3 broken away, RP^3 lost, C. M. No. 10000.

Skull, anterior portion, badly damaged, but rostrum in fair condition on right side. Posterior part of nasals preserved. RI and R and LM^{1-2} preserved, also stump of RP^4, C. M. No. 1135.

Left ramus of mandible with I and well-worn cheek teeth, C. M. No. 9998.

Horizon: McCarty's Mountain Oligocene.

Locality: Southeastern slope of McCarty's Mountain, Madison County, Montana, about sixteen miles north and a little east of Dillon, Montana.

Diagnosis: A smaller species than *Pseudocylindrodon neglectus* m.; lower jaw lighter, cheek teeth somewhat more brachyodont, hypoconids less produced laterally, hypolophid crest in P_4, internal intermediate cuspules absent on M_{1-2}, and central valley exits open, posterior valleys of molars not dammed at exits.

In dorsal profile the skull of *Pseudocylindrodon medius* m. is fairly evenly convex, except for some flattening in the interorbital and parietal regions. The occiput leans anteriorly to some extent (the condyles are visible in dorsal view). The dorsal profile in *Cylindrodon* appears somewhat more evenly and a little more strongly convex. The ventral profile of *Pseudocylindrodon medius* m. is broadly concave in the region of the diastema (anteriorly paralleling the dorsal profile, posteriorly diverging from it somewhat, but in this latter case not so markedly as in *Cylindrodon*). Along the tooth row the profile is essentially horizontal, *i.e.* flattened; it again approximates paralleling the dorsal profile in the pterygoid region. The audital bullæ, however, descend well below the pterygoids, and are most convex anteriorly. Neither *Cylindrodon* nor *Ardynomys* shows such ventral extent of the bullæ as the present species.

In superior view the brain case is somewhat pentagonal in outline caudad of the postorbital constriction; it is truncate posteriorly, expands laterally to the glenoid region, and then tapers anteriorly to the postorbital constriction, where the skull is quite narrow, as in cylindrodonts generally; there is again strong lateral expansion to the antorbital region. In degree of lateral expansion of the brain case caudad, from the postorbital constriction to the glenoid region, *Pseudocylindrodon* appears to approach *Ardynomys* rather than *Cylindrodon*, if I may judge from the mutilated skulls of the latter genera at my disposal. *Cylindrodon* would apparently come nearer to having the tubular "neck" in the postorbital region so characteristic of *Paramys* and *Sciuravus*, but it is not of the slender and more primitive type found in the Eocene forms; expansion of the brain case immediately caudad of the postorbital constriction seems to be a definite characteristic of the Oligocene *Cylindrodontidæ*. There is an interesting contrast between *Pseudocylindrodon medius* m. and *Ardynomys* in the region between the zygomatic process of the squamosal and the occiput; in *Ardynomys* the distance between these areas is lessened, due to the lateral flaring of the brain case and caudad shifting of the zygomatic process of the squamosal—both trends in the direction of *Tsaganomys*.

Both *Ardynomys* and *Cylindrodon* possess low but definite sagittal crests. In the present species a median crest, formed by orbital ridges which converge at the interorbital constriction, extends caudad to the neighborhood of the suture between the frontals and the parietals at which place it bifurcates. I am unable to trace the caudad reaches of these branches, however, since in C. M. No. 10001, the only skull showing the bifurcation, the dorsal surface of the paper-thin brain case is shattered away.

The dorsal profile of the occiput is more convex and angular than that of *Ardynomys*, and probably more than in *Cylindrodon* also, since in both the latter genera the lateral expansion of the brain case has depressed the skull in this region. The occiput is lower than in *Cynomys*, but not as low as in *Ardynomys* or *Aplodontia*. The *foramen magnum* is quite large, its width greater than its height, and subpentagonal in outline. The condyles are low and broad, and not well marked off from the skull, dorsally they extend but slightly laterad of the borders of the *foramen magnum*. There is no occipital crest comparable with the rather thin and sharp crest seen in *Cynomys*, but superior to the *foramen magnum* there is a large triangular, or better, arrowhead-shaped swelling of the supraoccipital, the apex dorsal; this structure produces some convexity in the occipital profile in lateral view.

The plane of the occipitals is fairly well marked off from those of the mastoids. The distinction between the mastoids and the occipitals is accentuated on the right side of C. M. No. 10001 because there has been some parting along the suture, but even on the left side the slope of the mastoid from the occipital plate, ventral above, anterolateral below, is well shown. Dorsally, the wings of the supraoccipital extend well laterad superior to the mastoids. The mastoid foramen seems to be almost entirely walled around by the bone of that name, however. The paraoccipital processes are short and blunt; even though they may have suffered some breakage in this skull, I doubt whether they ever extended below the condyles, against which they are much crowded. The marked narrowing or compression of the exoccipitals laterad of the condyles is one of the most characteristic features of the skull of this species.

The basioccipital is narrow, particularly in the region between the audital bullæ, where it is crowded. The median longitudinal crest is about as in *Neotoma*. The tendency for the basioccipital to build down on the median sides of the bullæ is slight, although the bullæ press against it. A small condyloid foramen is present on the caudo-median wall of the posterior lacerated foramen. A stapedial foramen is not shown. The posterior lacerated foramen is prominent and drawn-out anteriorly.

Laterally and anteriorly the parietals appear to have about the same extent as in *Ischyromys;* they almost reach the postorbital constriction. Concerning the interparietal I am unable to ascertain anything definite, due to the shattering of the brain case dorsally.

The extent that the posttympanic process of the squamosal overlaps the mastoid is considerably less than in *Ischyromys*, but at first glance the greater lateral exposure of the mastoid is not strikingly apparent, for the mastoid is not inflated as in the latter genus. Although it is somewhat difficult to trace the suture between the squamosal and the parietal, it is evident that the squamosal played a minor part in the formation of the skull roof, being restricted to the sides as in *Ischyromys*. Apparently, as in *Ischyromys*, the larger foramen postero-median to the postglenoid foramen in *Pseudocylindrodon medius* m. marks the suture between parietal and squamosal. The glenoid fossa is somewhat elongated antero-posteriorly, and is narrower transversely than that of *Arctomys*. The contribution of the squamosal to the zygomatic arch appears to have been slight, judging from C. M. No. 10001; it forms but a short part of the arch of this specimen, but there are some indications that it may have been damaged prior to fossilization; if such were the case, the zygoma may not have been as slender posteriorly as now appears.

In keeping with the reduction of the exoccipitals, the mastoids are transversely expanded below; the greatest lateral extent of each is about twice that of the adjacent portion of the exoccipital. Dorsally the mastoid is wedged in, medially by the body of the supraoccipital, dorsally and laterally by its descending lateral wing. There is a deep pit between the mastoid and the squamosal at the caudal side of the base of the mastoid process; this may lead into a foramen. In the present specimen, C. M. No. 10001, the mastoid process is small and not at all prominent. Between it and the external auditory meatus are found the tympanohyal pit and the stylomastoid foramen; the latter foramen is relatively small.

The audital bullæ are large and appear drawn out ventro-medially and anteriorly. They are compressed from a ventro-lateral direction, but more medially they are well inflated. In size, in their more uniform transverse dimensions (they show no marked tapering anteriorly and posteriorly) and in their marked inflation in a ventro-median plane they contrast with the bullæ of *Ardynomys* and *Cylindrodon*. In another respect, too, they differ from those of the latter two genera. Because thin fossil bone from the McCarty's Mountain Oligocene exposures is usually to some degree translucent, one can often study deeper details of the bone structure to considerable advantage; in the case of the audital bullæ of C. M. No. 10001 this holds true; by applying glycerine to the outer surface of the bone one can detect the structure of the internal surface of the bullar wall with considerable clarity; here one sees the *crista tympanica* carried well medially, and radiating from it, numerous bullar septa. This structure seems quite similar to that found in *Allomys cavatus* (Cope); indeed the entire bulla reminds me quite a little of the bulla of the latter, if I can trust Cope's illustration[1] and my memory of the type of that species, which I have never examined closely, but which I have seen in passing in the American Museum of Natural History. I do not find bullar septa of this type in our specimens of *Ardynomys* from the McCarty's Mountain Oligocene deposits and I have not discovered them in the skull of *Cylindrodon*, A. M. No. 14584 from the Beaver Divide, Wyoming. The audital meatus of *Pseudocylindrodon medius* m. C. M. No. 10001 shows the rudiment of a tubular ring, laterally directed, although the anterior lip shows some inclination forward; ventrally the rim is incomplete.

The suture between the basioccipital and the basisphenoid shows distinctly in this specimen. The basisphenoid is flat and in essentially the same plane as the basioccipital.

If present, the middle lacerated foramen must be insignificant. The audital bullæ are well rimmed with bone antero-medially, although in the region of the recess for the opening of the eustachian canal excavation cannot be carried to the point of demonstrating the presence or absence of the foramen.

The pterygoid is drawn out into a prominent but slender hamular process which extends to and contacts with the auditory bulla. Lateral to the pterygoid plate extends the external palatine plate, which splays laterally in its caudad course and ends in a free process. Although not elongate antero-posteriorly, the pterygoid fossa is quite wide for a skull of this size, even though the marked divergence of the pterygoid and external palatine plates be attributed to some extent to crushing of the specimen. It is also fairly deep, and the floor of the fossa is not crowded.

I believe one can be reasonably sure of the identification of the foramina of this region. In the pterygoid fossa there is a foramen of moderate size which has the position of the sphenopterygoid. Caudolateral to it, above the free external palatine process, we find the larger

[1] Cope, E. D., "The Vertebrata of the Tertiary Formations of the West." Rept. U. S. Geol. Surv. III, Pl. LXIII, Fig. 12, 1884.

inferior oval foramen. Anterior and ventral to the latter the root of the descending plate of the alisphenoid is pierced by an opening which occupies the proper location of the alisphenoid canal, in this case not at all as reduced as in the *Sciuridæ*, and easily discerned. Presumably the small foramen which occurs antero-lateral to this last, and which pierces the alisphenoid bone, being directed caudally (it would lead into the alisphenoid canal, in other words) is the masticatory foramen.

The sphenoidal fissure is large, slit-like, but broad transversely. The optic foramen is also prominent, and well separated from the sphenoidal fissure. Above and anterior to the optic foramen the anterior ethmoid foramen is shown. The sphenopalatine foramen is carried well forward (above M^1) but not as far as in *Aplodontia*. It is somewhat elongate antero-posteriorly, not rounded.

The frontals have an anterior extent dorso-medially nearly to the anterior orbital rim, and are but slightly invaded by the nasals. Caudo-median to the lacrimals, on the orbital rims, the frontals are slightly produced into what look like the rudiments of processes; more caudo-median arise the low orbital ridges, which converge posteriorly into a median crest.

The posterior palatine notch is carried anteriorly to a point opposite the anterior portion of the base of M^3—not quite as far anteriorly as in *Ardynomys* and *Cylindrodon*. The post-nareal trench is not narrow as in *Cylindrodon*, rather it approximates that of *Ardynomys*. The palate is narrowest in the region of M^1 and M^2; anterior to this place the tooth row bends laterally. The posterior palatine foramina show opposite the first molars but are not easily distinguishable from the maxillo-palatine sutures.

Posteriorly, a low ridge marks the maxillary suture, but in general the palate is smooth, more so than that of *Cylindrodon*, and without the better-defined ridges and channels of the *Ardynomys* palate. The maxillaries show little in advance of P^3; most of the area between P^3 and the incisor is taken up by the premaxillaries, which have an antero-posterior extent equal to that of the maxillaries. Considering the short rostral portion of the palate, the anterior palatine foramina have fair antero-posterior extent; they are confined to the premaxillaries, however. From the postero-lateral alveolar walls of the incisors low, sharp ridges converge to the anterior borders of the anterior palatine foramina. I have not detected an interpremaxillary foramen.

The zygomatic arch is slender, particularly when compared with that of *Cylindrodon*. In C. M. No. 10001 it roughly parallels the plane of the palate and does not drop to the level of the tooth row, although carried lower than that of *Aplodontia*. Its anterior root is not tilted dorsad from below to the extent seen in the zygomata of *Cylindrodon* and *Ardynomys*. The malar extends well dorsad against the zygomatic process of the maxilla, rising a little above the incisive swelling and well dorsad of the infraorbital foramen.

The zygomatic root of the maxillary is slenderly constructed, and strongly contrasts with the more robust structure seen in typical *Paramys*. Unlike the condition found in *Aplodontia*, there is no marked bending forward of that part of the zygomatic root which is ventral to the infraorbital foramen; in C. M. No. 10001 this portion of the root is moderately inclined forward before bending posteriorly as part of the arch. The zygomatic process of the maxillary is carried posteriorly to the vicinity of the posterior region of M^2.

The scar of the masseter muscle is not as distinct, or carried as far forward as in *Aplodontia*. The infraorbital foramen is of moderate size, and its anterior opening is visible in anterior and ventral views of the skull. In anterior view its course is seen to be somewhat oblique, rather than at a right angle to the lateral plane of the maxillary plate, but it does not excavate the plate dorso-laterally to any degree comparable with the condition found in *Aplodontia*.

Compared with those of *Ardynomys* and *Cylindrodon* the rostrum of *Pseudocylindrodon medius* m. is narrower transversely, and shows more tapering anteriorly. Neither *Cylindrodon* nor *Pseudocylindrodon* has quite the angular type of rostrum found in *Ardynomys*, although *Cylindrodon*, in the steep slope mediad of the inferior lateral wall of its rostrum differs from *Pseudocylindrodon* in the direction of *Ardynomys*.

The premaxillaries are somewhat short in posterior extent; they terminate just dorsad of the zygomatic or lateral plate of the maxillary and do not reach the interorbital region. Their contact with the frontals is slight, since they are crowded by maxillaries and nasals. The nasals in turn barely reach the interorbital region.

The nasals narrow posteriorly, but the narrowing is not at all as marked as in *Aplodontia*, and in the species under description these bones contribute to the crowding of the premaxillaries, as noted above. As the tip of the snout is approached the nasals again narrow, but not to the extent found posteriorly. Anteriorly, these bones are inflated, and project for a short distance anterior to the premaxillaries.

The lacrimal is a more prominent feature of the orbital border than that of *Cynomys*, and appears close to *Paramys* in extent and proportion in this region. The naso-lacrimal canal is essentially as in *Aplodontia*, but smaller.

The superior incisors of *Pseudocylindrodon medius* m. resemble those of *Cylindrodon*, differing strongly from those of *Ardynomys* in their lesser size and lack of flattening along the anterior face. In C. M. No. 10001 the incisors show a greater transverse than longitudinal measurement, but in C. M. No. 10000, a younger skull, the measurements are equal.

Taken as a whole, the superior cheek tooth row of *Pseudocylindrodon medius* m. bears quite a resemblance to that of *Ardynomys* when worn dentitions are compared, for the species under description shows oblique implantation of the superior cheek teeth and a degree of unilateral hypsodonty, approaching *Ardynomys* in these characters; consequently, with age the surface of wear of these teeth becomes increasingly broader on the protomere side, much as in *Ardynomys*,

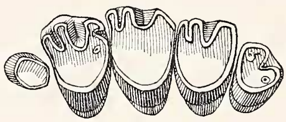


FIG. 1. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10001, occlusal view of left superior cheek teeth, × 5.

while considerable of the original pattern is lost. We are quite fortunate in that we have for comparison, in addition to the nearly complete skull C. M. No. 10001, in which the dentition is much worn, other specimens which show the teeth in earlier stages of wear. From these latter, in comparison with little worn superior cheek teeth of *Ardynomys*, it is apparent that the latter genus has already gone beyond *Pseudocylindrodon medius* m. in dental specialization, and not in unilateral hypsodonty alone, for the superior cheek teeth of *Ardynomys* have taken on some of the characters of *Cylindrodon* in that they are drawn out into longer shafts than those of *Pseudocylindrodon medius* m. and they expand less rapidly from the root to the occlusal surface. These specializations in *Ardynomys* have carried with them some changes of the dental pattern which may be summarized as consisting in increased lophodonty and its attendant pattern modifications, the crests and the walls of the crown have been elevated, and are more delicate, cusp-crest structure gives way to lophs, and the tooth valleys are narrowed and more enclosed as basins. *Pseudocylindrodon medius* m. on the other hand, preserves, with surprisingly little change, much of the dental structure of the *Mysops*-group, the stem-stock of the cylindrodont rodents; the species retains much of the low, rapidly expanding tooth crown of *Mysops*, well-marked cusp-crest structure, broad valleys and shows less unilateral hypsodonty than *Ardynomys*.

In keeping with the lesser specialization of the species in general, the P^3 of *Pseudocylindrodon medius* m. is less reduced than that of *Ardynomys*. The tooth is preserved in C. M. No. 10001, where it shows as a spike-like shaft, but stouter than that of *Ardynomys occidentalis* m. The tooth is well-worn in this specimen, subcircular in section, and has equal transverse and longitudinal dimensions.

The P^4 of the species under description is the largest superior cheek tooth. In occlusal view the tooth is somewhat triangular in outline, with the angles rounded (it is seen in an early stage of wear in C. M. No. 10000). The pattern, in general is like that of P^4 of *Mysops*, but with the paracone and the metacone more widely separated and hypocone not distinct after wear. Protoloph and metaloph elements converge to the protocone; the protoloph is a definite crest and no protoconule is indicated. The metaconule is large, quite a distinct cusp and triangular, expanding toward the floor of the crown; at its angles the cusp connects by narrow spurs with the metacone and the pro-

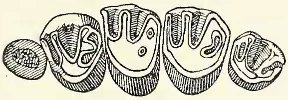


FIG. 2. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10000, occlusal view of P^4, M^{1-3} left, × 5.

tocone, and posteriorly with the posterior wall of the crown. The anterior cingulum is elevated and the crest produced anteriorly, bending rather sharply to meet the protocone internally. The anterior valley is narrow, the central valley broad and V-shaped. Due to the connection of the metaconule with the posterior wall, the floor of the posterior valley is divided into external and internal "basins," which become fossetes or isolated enamel islands with wear. The floors of the anterior valley and of the posterior "basins" are higher than that of the broad central valley; the exit of the anterior valley is open, but that of the posterior valley, or better, postero-external "basin," is closed, due to fusion of the metacone and the posterior wall. The metacone projects well externally beyond the dam thus formed.

There is an intermediate tubercle in the outlet of the central valley in P^4 of C. M. No. 10000, but the tubercle is absent in P^4 of C. M. No. 10001. The tubercle bulges the crown externally at the outlet of the valley in C. M. No. 10000, a feature not found in C. M. No. 10001 also. P^4 in C. M. No. 10001 is well worn, but shows the postero-internal "basin" as a small enamel island. The postero-external "basin" of this tooth is not yet isolated as an island, due to a low gap in the posterior wall at that place.

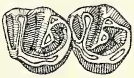


FIG. 3. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 1135, occlusal view of LM^{1-2}, × 5.

The molars of this species have the essentials of the pattern of P^4, and bear marked resemblances to those of *Mysops* likewise. The main pattern difference between P^4 and the molars of *Mysops* and the same teeth in *Pseudocylindrodon medius* m. is found in the metaconule and bordering elements; the metaconule has better connections with the metacone and the protocone, and a (usually) strong connection with the posterior wall with wear. (As a matter of fact, in M^2 the connection with the posterior wall is well down toward the floor of the tooth.)

The transformation of the *Mysops* molar into that of *Pseudocylindrodon* is not hard to visualize. Several workers have noted the unimportant role that the hypocone plays in *Mysops*, and its close proximity to the protocone. It is evident that the merging of hypocone and protocone to form the internal shelf is already well under way in *Mysops*. It has gone even farther in *Pseudocylindrodon*, and after a very little molar wear, one cannot distinguish the two cusps. I am fortunate, however, in having one specimen, (C. M. No. 1135) in which protocone and hypocone can be made out in M^1 and in M^2 but a slight amount of wear would even eliminate the internal enamel reentrant which demarks them. This reentrant is more persistent in *Mysops*. In *Pseudocylindrodon medius* m. the merging of the hypocone and the protocone may have been in itself sufficient to draw the internal reaches of the posterior wall anteriorly and impinge the wall against the large metaconule. But more likely this is not the whole story; we must not forget that the entire tooth is being affected by a common trend, and that we see here a stage in the transformation of a low crowned, wide flaring tooth to a higher crowned, more cylindrical shaft, in which process all the elements of the original occlusal pattern undergo crowding and readjustment.

At early stages of wear the molars have more of a quadrangular, rather than triangular appearance, since the migration of the surface of wear internally is less evident. Even then, however, their walls are produced internally in the region of the protocone, and externally, but much less so, at the outlet of the central valley, if the intermediate tubercle is present at that place. I do not attach any particular significance to the presence or absence of the tubercle, particularly since I find it present in RM^1 of C. M. No. 10000, and absent or only indicated in LM^1 of the same specimen. It is not shown in the second molars of C. M. No. 10000, but does occur in the third molars. It appears to be present or indicated in M^{1-2} on both sides in C. M. No. 1135, but is lacking in the molars of C. M. No. 10001.

The molars show a progressive decrease in size posteriorly, although the discrepancy between M^1 and M^2 is most evident in early stages of wear. The triangular outline of M^1 in most specimens is a product of wear, a factor which enters into almost any consideration of outline and pattern of cylindrodont teeth.

Contrary to the situation in P^4, the internal "basin" of the posterior valley sinks as low or lower than the central valley in M^{1-3}. Because of the greater depth at which the metaconule connects with the posterior wall in this tooth, M^2 bears resemblance to M^2 of *Mysops*, which has the posterior valley clear.

The posterior wall or cingulum crest in M^{1-2} is, as in P^4, connected with the metacone to block the posterior valley outlet, and as in P^4 the cingulum joins with the latter cusp well internal to its extreme lateral reaches, the posterior cingulum being of short transverse extent. Nevertheless, the posterior valley has the farthest internal extent of the transverse valleys of the crowns of these teeth.

The M^3 of C. M. No. 10000 is not badly worn and shows an interesting construction; the outlet of the posterior valley is not closed but opens posteriorly; the posterior cingulum and the metacone are not fused. This condition is much like that found in the molars of *Ardynomys.*

The mandible of this species is lighter than those of *Cylindrodon* and *Ardynomys;* it is also smaller and considerably lighter than that of *Pseudocylindrodon neglectus* m. The ramus is deep anteriorly, with the greater depth beneath P_4, yet there is a more rapid decrease in depth posteriorly than in *Cylindrodon.* In this last feature there is some approach to the ramus of *Ardynomys*, but in *Pseudocylindrodon medius* m. there is no flange-like ventral extension of the mandible such as is found in *Ardynomys*, and which renders the rami of the latter genus angular by emphasizing their anterior depth. While the symphysis is carried as far posteriorly as in *Cylindrodon* (beneath P_4) the articular area is not as extensive or roughened as in that form, particularly in its ventral and its posterior reaches.

The diastema would appear to be somewhat shorter than that of *Pseudocylindrodon neglectus* m. There are two mental foramina in the species under description, as in the species from Pipestone Springs; the anterior and larger of these occurs below P_4, or, as in one specimen, C. M. No. 9933, a little in advance of that tooth. In *Pseudocylindrodon* the prevailing tendency is for the mental foramina to be placed behind the diastema.

The masseteric fossa is rather shallow. The ridges for the masseteric muscles are not as prominent as in *Ardynomys*, *Cylindrodon* or *Pseudocylindrodon neglectus* m. The dorsal masseteric ridge also rises at a lower angle than in the latter forms. The masseteric scar does not extend anteriorly in advance of M_2.

In C. M. No. 9999 the coronoid process is broken off at the base; at that place it was extended antero-posteriorly, and must have presented much the same appearance as that of *Ardynomys chihi* M. & G., where it shows as a low plate, antero-posteriorly expanded. The anterior border of the coronoid process appears to have risen at a lower angle than in *Ardynomys*, *Cylindrodon* and in *Pseudocylindrodon neglectus* m.

The condyle is placed low. The articular surface is irregularly rounded, and, on the lateral side, extended, tapering ventrally. The angle arises from the base of the incisive alveolus. Above it the ascending ramus is more convex laterally than that of *Cylindrodon.*

The dental foramen is found posterior to M_3, just dorsad of the ridge extending from the base of the tooth row to the condyle. The fossa for the insertion of the internal pterygoid muscle is extensive and well excavated, in keeping with the broad pterygoid fossa of the skull.

The mandibular incisor of this species differs from that of *Pseudocylindrodon neglectus* m. is showing less transverse compression; the tooth shows only a slightly greater antero-posterior than transverse measurement. Its anterior face is rounded, much as in *Cylindrodon;* there is no suggestion of the flattening found in *Ardynomys.*

The mandibular cheek teeth of *Pseudocylindrodon medius* m. are definitely of the more brachyodont type found in *Ardynomys* and *Pseudocylindrodon neglectus* m. and contrast with the higher-crowned cheek teeth of *Cylindrodon.* "Unicuspal" hypsodonty is less evident than in *Pseudocylindrodon neglectus* m.; in the species under description there is less of a tendency for the enamel of the crown to be carried down the hypoconid root.

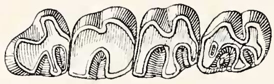


FIG. 4. *Pseudocylindrodon medius* Burke, holotype, C. M. No. 9999, occlusal view of mandibular cheek teeth, $\times$ 5.

Unlike that tooth in *Pseudocylindrodon neglectus* m., P_4 shows greater antero-posterior than transverse dimensions. The trigonid is elevated and relatively more transverse than in P_4 of the Pipestone Springs species, but as this tooth is either too worn or else damaged in the trigonid region in my specimens I cannot compare the trigonid cusps. Wear may also have eliminated the protolophid, if the crest were present. A distinct hypolophid is shown (the hypolophid is absent in the holotype of *Pseudocylindrodon neglectus* m.). The hypolophid in P_4 of *P. medius* is a strong crest, not reduced as in *Ardynomys occidentalis* m.; it extends antero-externally from the entoconid, its direction paralleling the course of the attenuated hypoconid. Due to the presence of the hypolophid crest, both the central and posterior valleys are distinguishable in this tooth, in contrast with the situation in P_4 of *Pseudocylindrodon neglectus* m., in which there is but a single valley, or rather, a basin, the floor of which is rounded, in this region. The central valley in the species under description is V-shaped, transversely directed, and rapidly widens to its internal exit. The entoconid is drawn posteriorly, and at its base is fusing with the hypoconulid ridge. As in *Pseudocylindrodon neglectus* m. the hypoconid is drawn out laterally and anteriorly, but it is not carried as far forward as in that species; in consequence, the broadly U-shaped external valley has more of an obliquely transverse, rather than antero-posterior direction, than in P_4 of *Pseudocylindrodon neglectus* m. The hypoconulid ridge originates from the postero-internal side of the out-jutting hypoconid and is directed postero-internally until it reaches the posterior wall of the tooth, then its course becomes sharply transverse. The crest becomes delicately attenuated in its internal extent. The posterior valley constricts and narrows to its internal exit, due to the close approximation of entoconid and hypoconulid ridge; the internal exit is quite narrow, and the ridge and cusp fuse below, elevating the valley exit. There is no cuspule in the outlet of the external valley, such as one finds in P_4 of the holotype of *Pseudocylindrodon neglectus* m.

The mandibular first molar of *Pseudocylindrodon medius* m. also contrasts with that of *Pseudocylindrodon neglectus* m. in proportions; its transverse measurement is only a little greater than its antero-posterior measurement, whereas in the Pipestone Springs species M_1 is much more transverse in the talonid region, with the hypoconid strongly produced. In C. M. 9999 M_1 is so much worn that many details of the original crown pattern are not distinguishable. A trace of the shallow central valley still remains; its general course is transverse, with a slight postero-external trend; it forms a less angular V than the central valley of P_4. The exit is clear; there is no internal intermediate cuspule such as occurs in *Pseudocylindrodon neglectus* m.

If one can judge from the antero-posterior extent of the talonid on the internal side of M_1 of C. M. No. 9999, this tooth unworn would not have shown the crowding and fusion of hypoconulid crest and entoconid observable in M_1 of *Pseudocylindrodon neglectus* m. There is hypertrophy of the hypoconid in M_1 of *Pseudocylindrodon medius* m., but in this region the crown bears more resemblance to that of *Ardynomys* than to *Pseudocylindrodon neglectus* m.; in fact, the entire tooth makes an approach to M_1 of *Ardynomys.* Since the hypoconid is not produced antero-externally as markedly as in M_1 of the genotype of *Pseudocylindrodon*, the external valley is less extensive than in that species. There is no cuspule in the outlet of the external valley.

In *Pseudocylindrodon medius* m. the antero-posterior measurement of M_2 exceeds the transverse measurement—the reverse of the condition found in *Pseudocylindrodon neglectus* m. In C. M. No. 9999 this tooth is not badly worn, but the protolophid has been eradicated. It must have been carried high on the trigonid, and may have been short and crowded against the trigonid cusps. The central valley is U-shaped, and wide throughout its course. There is no cuspule at the exit of the valley, but the posterior shoulder of the metaconid is carried well back toward the entoconid, which has the effect of raising the valley floor somewhat at the exit.

The posterior valley is also U-shaped at its initiation, but becomes somewhat constricted at its exit, due to the incipient fusion of the entoconid with the hypoconulid crest. The course of the latter crest is somewhat as in P_4, but the crest is less attenuate on the internal side. It is also short, not reaching as far internally as the entoconid does (this condition probably held true in M_1 as well). Hypertrophy of the hypoconid is not marked, but the cusp wall is somewhat produced externally. The external valley is nearly transverse.

It can be seen that this tooth preserves in detail many of the features of the tooth pattern of the *Mysops* stock of Eocene rodents—probably more so than does M_1 of any other Oligocene cylindrodont.

The M_3 of C. M. No. 9999 also shows greater extent antero-posteriorly than transversely. The tooth is not badly worn and preserves practically all details of the pattern. The protolophid is shown carried well up on the trigonid, extending from the protoconid to the posterior side of the metaconid; it does not reach as far internally as in M_3 of *Pseudocylindrodon neglectus* m.; the anterior valley is also narrower than in the latter species. The central valley is rounded (basin-like) with a tubercle rising from its floor and from the posterior side of the metaconid. The tubercle in this case is probably an individual variation, rather than a character of specific value. The internal exit of the central valley is almost entirely closed off; an intermediate tubercle is present, and, as in M_3 of *Pseudocylindrodon neglectus* m., it fuses with the posterior shoulder of the metaconid and with the entoconid, damming the central valley almost essentially as in the latter species. The entoconid is enlarged, extended antero-posteriorly and drawn out into a strong triangular hypolophid crest. The posterior valley narrows at its internal exit, where its valley floor rises, but the valley remains open. The talonid is narrower transversely than the trigonid; the hypoconulid crest is short, not reaching internally as far as the entoconid does. The external valley has more of a postero-median direction than that of M_2.

Pseudocylindrodon medius m. is the most conservative of the known Oligocene *Cylindrodontidæ.* While it has advanced beyond Eocene rodents such as *Sciuravus* and *Paramys* in such specializations as expansion of the brain case, modifications in the occipital region and an advanced type of auditory bulla, it does not show the extreme skull trends in the direction of *Tsaganomys* that are found in *Ardynomys*, and, but to a much lesser degree, in *Cylindrodon. Pseudocylindrodon medius* m. cannot be compared with *Cylindrodon* in dental specialization, for the latter species is the extreme among its contemporary cylindrodonts in this respect. Even *Ardynomys* has outstripped *Pseudocylindrodon medius* m. in dental structure. The dentition of the present species makes the nearest approach to that of the Eocene genus *Mysops* known among Oligocene rodents, and *Pseudocylindrodon medius* m. furnishes a most satisfactory link between *Mysops, Pareumys* and Oligocene cylindrodonts such as *Ardynomys* and *Cylindrodon.*

MEASUREMENTS.

Holotype right mandibular ramus, Carnegie Museum No. 9999.

	mm.
Mandibular I anteroposterior	1.8
Mandibular I transverse	1.7
P_4 anteroposterior	1.9
P_4 transverse	1.8
M_1 anteroposterior	1.8
M_1 transverse	1.9
M_2 anteroposterior	1.7
M_2 transverse	2.0
M_3 anteroposterior	2.0
M_3 transverse	1.8
Anteroposterior length of mandibular tooth row	6.9
Anteroposterior length of inferior molar series	5.0
Length of diastema between mandibular I and P_4	2.3
Depth of ramus under M_1	4.9

Referred specimens, skulls, Carnegie Museum Nos. 10001 and 10000.

	C. M. 10001 mm.	C. M. 10000 mm.
Greatest anteroposterior length of skull (anterior tips of nasals to occipital condyles)	29.4	....
Length of skull, anterior face of incisors to inferior margin of *foramen magnum*	26.0	....
Length of skull, anterior face of incisor to occipital condyle	27.8	....
Length of skull, anterior face of incisor to supra-occipital	27.7	....
Width of rostrum at premaxillary suture	8.5	8.0
Greatest width of maxillary region of zygomata	16.2	....
Width of skull at postorbital constriction	5.3	....
Greatest width across zygomatic arches (equals greatest width of squamosal region of arches)	19.5*	....
Distance between postglenoid foramina	8.9	....
Distance between postero-ventral tips of posttympanic processes of squamosals	14.0**	....
Depth of rostrum at premaxillary suture	6.2	....
Height of skull above M^1	8.0	8.4
Height of skull, occipital condyles to dorsal margin of supraoccipital	7.5	....
Least anteroposterior measurement of bony palate	11.6	11.1
Least breadth of palate inside molars	2.5	3.0
Greatest breadth of palate inside P^4	4.1	3.6

*Estimated.

**Actual measurement; specimen crushed on right side.

	C. M. 10001 mm.	C. M. 10000 mm.
Anterior border of postnareal trench to posterior border of basisphenoid	8.2	....
Anterior margin of basioccipital to *foramen magnum*	5.9	....
Tympanic bulla, greatest anteroposterior measurement	7.2	....
Tympanic bulla, greatest transverse measurement	6.2	....
Greatest width across occipital condyles	7.1	....
Height of *foramen magnum*	4.1	....
Width of *foramen magnum*	5.4	....
Superior margin of *foramen magnum* to dorsal margin of supraoccipital	3.3	....
Superior I anteroposterior	1.6	1.7
Superior I transverse	2.0	1.7
P^3 anteroposterior	1.0	....
P^3 transverse	1.0	....
P^4 anteroposterior	1.7	1.9
P^4 transverse	2.6	2.3
M^1 anteroposterior	1.5	1.6
M^1 transverse	2.6	2.5
M^2 anteroposterior	1.5	1.6
M^2 transverse	2.1	2.3
M^3 anteroposterior	1.6	1.5
M^3 transverse	2.0	1.9
Anteroposterior length of maxillary tooth row	7.1	7.2
Anteroposterior length of superior molar series	4.2	4.3
Diastema between superior I and P^3	4.7	4.9

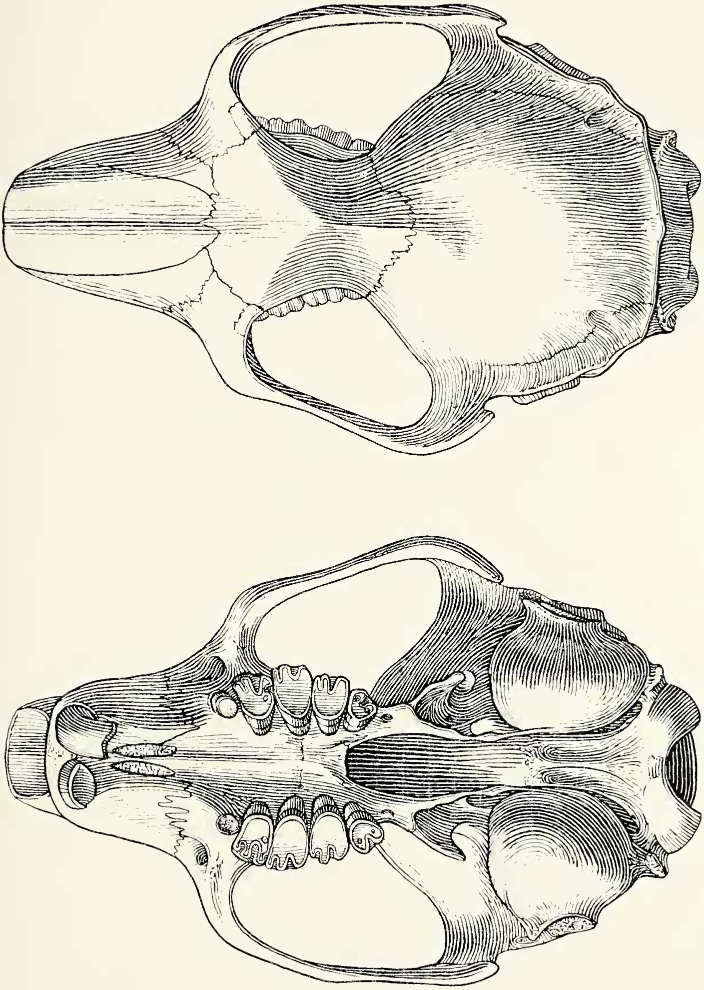
EXPLANATION OF PLATE XXVI.

All figures × 3.

(In the accompanying figures of the skull of specimen, C. M. No. 10001, the left zygomatic arch, the right pterygoid region, and the roof of the brain case in the parietal region, are shown in restoration.)

FIG. 1. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10001, palatal view of skull.

FIG. 2. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10001, superior view of skull.



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Pseudocylindrodon medius Burke.

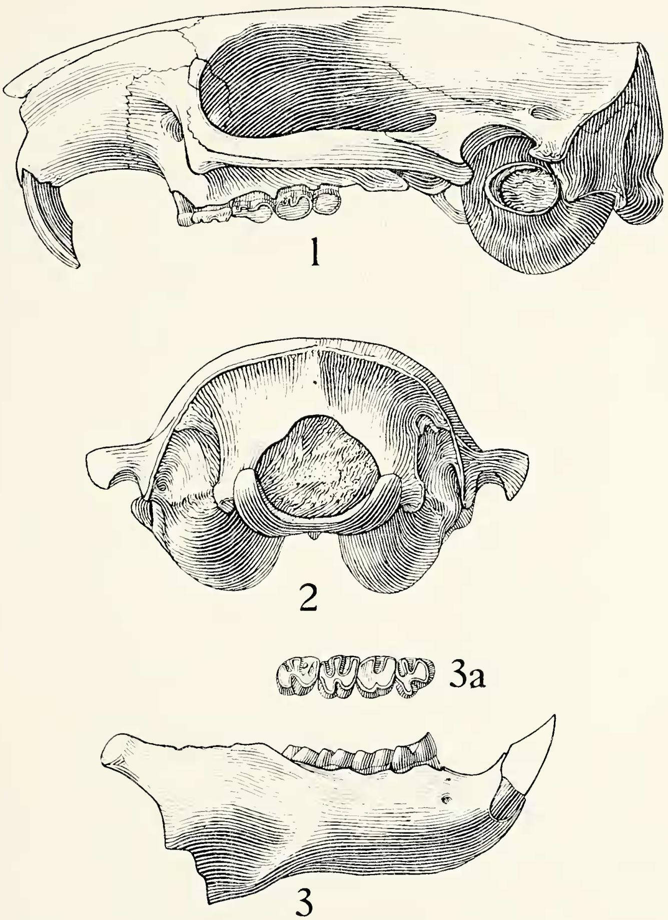
EXPLANATION OF PLATE XXVII.

FIG. 1. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10001, lateral view of skull.

FIG. 2. *Pseudocylindrodon medius* Burke, referred specimen, C. M. No. 10001, occipital view of skull.

FIG. 3. *Pseudocylindrodon medius* Burke, holotype, right ramus of mandible, C. M. No. 9999, lateral view.

FIG. 3*a*. *Pseudocylindrodon medius* Burke, holotype, C. M. No. 9999, occlusal view of RP^4, M^{1-3}.



Pseudocylindrodon medius Burke.